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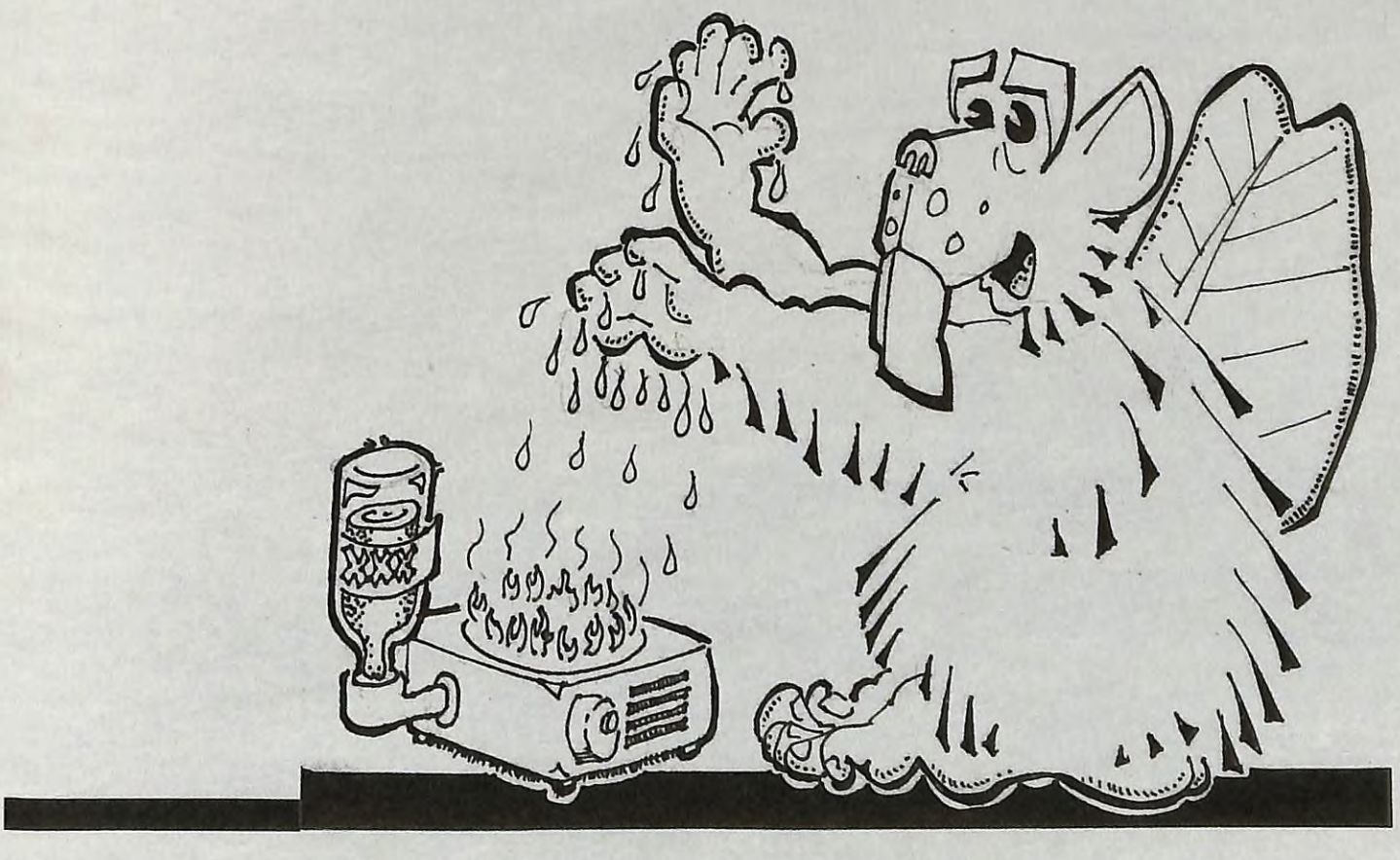
Moisture Generated by Fuels



From the Editor . . .

I have often ranted about the suburban sprawl that seems to be the pattern of so much of our residential development. It is an easy rant when one observes the seemingly endless parade of subdivisions, which brings along with it ever longer lines of urban traffic and gridlock.

At this time of reawakening environmental concern, we need to seriously examine our behaviour on all fronts, not just the goods and services we buy, but all our activities, including how and where we live.

As homebuilders, we can have a big impact on peoples' behaviour, because what and where we build sets the tone for the community and how it operates. We tend to focus on the four walls and ceiling defining the house, which most "green building" programs deal with. But environmental consequences include more than that. A huge house on a half acre lot, in a location where every member of the household needs a 3 ton vehicle to get anywhere for anything, is not green, no matter how resource efficient the materials, and how energy efficient it is. "Green" community layout is important too, so that access to work, shops, schools, play spaces is available by walking, transit or cycling as well.

However, builders are often at the mercy of the developer and planning fraternity. Ganging up on developers and planners and the sprawl they develop is easy to do. They often are the environmentalists' favourite whipping boys when it comes to land development and building issues. That is why I think that Radiant City, a recently released docu-drama by Calgary filmmaker Gary Burns and journalist Jim Brown should be mandatory viewing for all city planners, city politicians and developers.

The movie takes as its starting point the idea that suburban life is the norm across North America. It takes viewers inside the daily life of a typical family in a suburban Calgary community – mixing real-life tract-home dwellers with social experts, including the writer who sums up most suburban development as "brutal, depressing and spiritually degrading." The film follows the family as they justify their feelings (both positive and negative) towards their sleek, faceless neighborhood, despite all the trappings that have been applied in the marketing statements for the development.

The film specifically examines how the suburban landscape, with its sprawling street layouts, uniform houses, playgrounds, schools and strip malls, continues to shape and define the lives and perceptions of these individuals - from the mother's organizing the logistics of family life with the precision of a military planner, to the father's involvement with a local community theatre that makes fun of the suburbs to the children's feelings of ennui and sense of removal from the neighbors in their subdivision.

This movie not just a suburb bashing exercise – as is pointed out in the movie, everyone needs to live somewhere. The issue that is presented points out that in reality new developments fall short of the idyllic imagery used at the outset when they are being laid out. When we add to that the reality of peak oil, and the need to deal with energy issues for transport, the design of many new suburbs are not sustainable in the long term. Retrofitting a community, especially one that is designed around the individual automobile for the smallest trip for a loaf of bread or a jug of milk, because of the distances involved, will be extremely difficult.

Taking a look back in history at development patterns offers ideas on how suburbia could be done to provide the vibrant liveable and sustainable communities we are aiming for. Grappling with climate change issues is not going to be easy, and in the end each and every one of us will have to take action, and reconsider what and how we do it. This will also mean reviewing community development patterns.

Radiant City may not be as earth shaking a movie as Al Gore's An Inconvenient Truth, but it is an entertaining and informative movie that should be seen by all local politicians, planners and developers who make decisions how our communities are laid out.

Richard Kadulski,
Editor

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Combustion Gas Moisture Generated by Vent-Free Fireplaces

Mankind discovered fire and put it to use thousands of years ago. Ever since, fire has not only been a fundamental element helping us to exist on this planet, it has also been a source of fascination. Today, we still rely on fire for the most fundamental processes, but in the developed world it is mostly kept confined to select applications, whether for fuel-fired space and domestic hot-water heating equipment, or in thermal-generating stations to generate much of our electricity.

However, the fascination with fire is still with us. Perhaps it's the primal urge for the basics of life. Perhaps it's the totally unpredictable and organic movement of a flame. Perhaps it's the cultural notion many grew up with, sitting in front of an open flame around the campfire or in front of the fireplace on a cold winter evening, especially if snuggled up with that someone special.

In North America, perhaps more so than in many other parts of the world, it seems that a fireplace in every home is a must-have, even in the most hip urban environment, far removed from the countryside and the wood lot. Wood-burning fireplaces are messy and release significant amounts of particulate matter, contributing to air pollution and limitations on their use, especially in cities. Wood supply is often a challenge in urban areas, a fact the manufacturers of gas appliances identified years ago when they developed gas fireplaces.

Today, gas fireplaces have become the norm in many areas. They are clean burning and do not rely on wood deliveries. With the evolution of holography, fireplaces don't even need to have a flame. New electric fireplaces have the look of a traditional flame without the associated venting issues, nor the overheating potential, which can be a concern in an energy efficient home.

The hearth products industry manufactures some natural gas-fired products that claim to be vent-free. In these units, the combustion gases generated dissipate into the house. Virtually every state in the United States has allowed their use. In Canada, it has been recognized that there are serious concerns about the impact of unvented combustion on the health and safety of the occupants in our homes, which on the whole are quite airtight. That is why Canadian standards do not permit vent-free gas-fired appliances.

Recently, new alcohol-fuelled fireplaces have appeared. These are being promoted as clean burning, vent-free fireplaces. They are touted as being "environmentally friendly" largely on the premise that the fuel (denatured ethanol) is produced by the fermentation of sugars originating from agricultural and forestry products. Because it is made from biological products, it is considered to have a neutral ecological balance. The combustion of ethanol (also known as ethyl alcohol) has as its main byproducts heat, steam and carbon dioxide, and consequently is considered by the industry to be clean.

The appeal of the vent-free (flue-less) units is the lack of need for a utility connection, nor is there a need for vents, which can be a challenge to fit into urban homes, especially apartments.

The core is a burner box where the fuel is placed, and supports the flame. The life of the fire is determined by the amount of fuel placed into the burner, and once it has burnt, there is nothing to clean or clear. With a thermal input of 13,000 BTU, these are not insignificant fondue heaters or food warmers.

The *EcoSmart® Fire*, an Australian-developed product, is a vent-free fireplace now being marketed in Canada. The marketing heavily promotes the environmental angle. Its design is attractive, so there is also a play toward the design community for the clean lines of the fireplace.

This type of product doesn't fit under any standards that exist for gas, oil or wood burning appliances. As often happens in situations where new products for which no standards exist are introduced, the manufacturer used a test best suited to their purpose. In this case, the manufacturer has done some due diligence, and has tested their product in accordance with portions of the Australian gas space heater standard. In Australia, every state allows vent-free gas fired appliances, which was presumably the basis of testing for their alcohol fireplace.

In the USA, they had the Underwriters Labs

develop a test (which may well cover basic fire safety issues). They are trying to get approvals for use of the equipment in Europe. Testing has focused on CO/CO_2, fuel consumption ratios, flame stability, ignition safety, heat output, combustion characteristics and operational features.

The Canadian distributor has indirectly recognized there is a need for air change, otherwise it may be a potential concern for the indoor air quality. They state on their web site that the vent-free fireplace will be acceptable in a house of "typical construction" – in other words, one that is not "unusually (air) tight construction due to heavy insulation and tight seals against air infiltration". Unfortunately, no definitive numbers are offered as to what "typical construction" airtightness is, although we have the tools to test every house. In fact, every house that is Energuide rated will have a fan door test to establish just how tight it is. And some Canadian houses – not necessarily R-2000 homes, are extremely airtight, especially on the Prairies, where houses with 2 air changes @ 50 Pa are common.

The assumption being made is that an adequate supply of air for combustion and ventilation is provided through infiltration in a leaky house. The suggestion is also made that these units should not be used in small rooms – a room with an eight-foot ceiling should be at least 325 square feet in area or else the doors to adjacent rooms need to be kept open or a window to the outside should be opened at least one inch to guard against potential build up of indoor air pollution.

We know from the Energuide for Houses data that significant numbers of Canadian homes, especially newer units, are being built increasingly more airtight. Not every house has an adequate amount of air change to provide even basic ventilation to meet occupant needs for healthy indoors, let alone enough air change to deal with combustion moisture and other gases from a vent-free appliance.

Australian Regulations for Unvented Gas Fired Equipment

The state of Victoria in Australia has modified their regulations for vent-free appliances, which are widely used in Australia.

Ventilation Requirements

Each room with a vent-free appliance must have two outside vents with a minimum free area of 250 cm^2 (this is equivalent to an opening with a free area of about 6x6 inches) - one near the ceiling, and one near the floor. The purpose of this requirement is to ensure that there is an adequate minimum air change in the room to prevent the build-up of pollutants over time. (Evidently, vents with this area negate the attempt to create comfortable, draft-free building envelopes!)

If the vent-free appliance is installed in the same room as a gas cooktop, the cooktop must have a range hood vented outside, to reduce the potential for the combustion products from the cooking appliance to add to the emissions from the vent-free heater.

Allowable Emission Levels

The allowable emission level for NO_2 from vent-free gas heaters was reduced from 5 ng/joule to 1.8 ng/joule.

Limit On Formaldehyde Emissions

An emission limit for formaldehyde has been set at 2 Ng/Joule, which meets World Health Organization guidelines.

Maximum Size For Vent-Free Heaters

The regulations specify a maximum of 0.15 MJ/hr per cubic metre of room volume (or approximately 3225 BTU/100 sq.ft. with an 8 foot ceiling) with an absolute limit on the heating output of the vent-free heaters of 25 MJ (23,700 BTU).

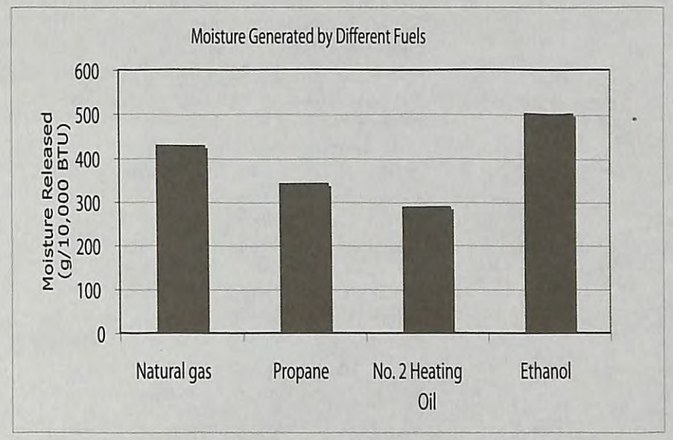
Limits on Use

Vent-free heaters are not allowed to be used in bedrooms and bathrooms.

The Australian climate, as most know, is not particularly harsh. The heating loads are small, and their construction practices are dominated, for the most part, by the need to deal with excessive heat, and the need to cool indoor spaces.

Air leakage does not have as significant an impact on the average Aussie house as is the case in Canada. Even in the mildest regions here, the concern is for space heating – the hot summers when cooling is of interest are fairly short. Consequently, Canadian construction practices need to focus on energy conservation and stress the importance of airsealing and managing air change. Two 250 cm^2 vents in a room would not be tolerable in Canada, especially when it's -20°C outside.

EcoSmart® Fire distributor: Vancouver Gas Fireplaces, Vancouver, BC www.vangasfireplaces.com



Moisture generated for each 10,000 BTU of fuel burned per hour

Indoor Air Quality Impact

Alcohol, like natural gas may be a clean burning fuel, but there are still combustion products produced, as there are impurities in the fuel. However, the major product of combustion is water vapour.

The water formed during combustion can be a condensate, as in condensing gas furnaces. In an appropriately designed condensing appliance, a significant portion of the energy in the water formed as a result of combustion (the latent heat loss) can be recovered and because of the lower flue gas temperatures, additional sensible heat loss is also recovered, with the combined result of an appliance having a significantly improved steady state efficiency.

To determine the effect on indoor air quality when alcohol or gas is burned, an analysis was done by the Integrated Energy Systems Laboratory, a division of the Sustainable Buildings & Communities Division of Natural Resources Canada. They did an analysis of the combustion products of several different fuels. The basis for comparison was set as 10,000 Btu/h heat input, similar to that of a low heat input fireplace.

A natural gas fireplace with a heat input of 10,000 Btu/h will release 432 g/h (0.95 lb/h) of moisture.

A propane fireplace with a heat input of 10,000 Btu/h will release 345 g/h (0.76 lb/h) of moisture.

Number 2 heating oil, which is essentially the same as diesel fuel, is a crude oil distillate. It has a heat content of 45,566 kJ/kg or 19,590 Btu/lb. For heating oil to generate 10,000 Btu/h it is necessary to burn 0.51 lb (232 g) of oil per hour, and the moisture formed per hour would be about 292 g.

Ethanol and isopropyl alcohol are the most common gelled fuels used in fireplaces. Additives such as salt are added to enhance flame colour or add some noise to the combustion process. The fuel formulations vary somewhat, and the alcohol itself can be anywhere from 70% to 85% of the fuel, the balance can be assumed to be water. For every 10,000 Btu of fuel, 506.0 g of water will be produced. (This is equivalent to ½ liter of water per hour.)

Thus, for the same heat input (10,000 Btu/h), the gelled ethanol would produce 1.2 times as much moisture as an equivalent natural gas fireplace, 1.5 times as much moisture as an equivalent propane fireplace and 1.73 times as much moisture as an equivalent No. 2 heating oil fireplace.

Higher levels of moisture in the combustion products provide an opportunity to recover more latent heat in condensing appliances. In vent-free heaters or fireplaces, all of the moisture formed from combustion and any other pollut-

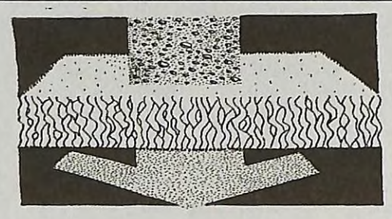
ants formed during combustion, such as carbon monoxide (CO), aldehydes, and nitrogen oxides (NO_X), is released into the living space. If the fuel and/or the burner becomes contaminated through accidental and/or deliberate actions from the end user, then the combustion process will be degraded and CO will be formed.

It is questionable if these vent-free ethanol fireplaces can be considered as being a "safe" product for use in Canadian homes.

There is a possibility that the NO_X formed during the combustion of ethanol may not meet Canadian IAQ requirements, because when ethanol is used as a replacement for gasoline or diesel fuel then the NO_X emissions tend to go up. Comments found on the Internet suggest that end users, in a quest to find a cheaper source of fuel for this type of vent-free fireplace, are resorting to making their own fuel. In some cases this includes replacing the cans of fuel with large candles, using liquid ethanol, or mixing candle wax and liquid ethanol in the fuel cans. Such practices could lead to high CO and/or aldehyde emissions.

Requiring a vented product would not prevent people from making their own fuels, but it would at least provide a measure of protection against them poisoning themselves. ☼

Fuel combustion analysis: An Estimation of the Water Formed During the Combustion of Natural Gas, Propane, Oil and Gelled Ethanol (In Gas Fireplaces) prepared by Martin Thomas, Integrated Energy Systems Laboratory, Sustainable Buildings & Communities, Canmet Energy Technology Centre - Ottawa



Understanding Filter Efficiency

MERV Filter Ratings			
	Particle size range		
MERV	3 to 10 µm	1 to 3 µm	.3 to 1 µm
4	<20%	-	-
5	20-35%	-	-
6	35-50%	-	-
7	50-70%	-	-
8	>70%	-	-
9	>85%	<50%	-
10	>85%	50-65%	-
11	>85%	65-80%	-
12	>90%	>80%	-
13	>90%	>90%	<75%
14	>90%	>90%	75-85%
15	>90%	>90%	85-95%
16	>95%	>95%	>95%

The ASHRAE test method to determine the efficiency of filters has changed. The old way of testing was done based on the mass of particles removed by the filter or its arrestance. However, the arrestance was based on specified particle size. If the threshold is set quite large, the filter can appear to be quite efficient. In part, the confusion with the old rating system was that most filters were 95%+ efficient, but for varying particle sizes, some quite large.

For air filtration, the critical particle sizes are the small ones, less than 10 microns in size, as these are the particles that remain floating in the air, and that can be inhaled and cause lung damage.

The new standard is 52.2, and quantifies a filter's efficiency against particle size. The ratings are expressed as a MERV (minimum efficiency reporting value). Typical MERV values are listed in the table.☼

Formaldehyde Regulations in California Buildings

The California Air Resources Board (ARB) adopted regulations at the end of April 2007 that require manufacturers of composite wood products including particle board, MDF (medium density fiberboard), and interior plywood to reduce formaldehyde emissions to protect public health.

In 1992, the US Environmental Protection Agency designated formaldehyde a probable carcinogen and the state of California named it a toxic air contaminant with no safe level of exposure. A decision by the International Agency for Research on Cancer to upgrade it to a known carcinogen in 2004 and growing evidence of its ability to damage DNA, reduce lung function, and do other bronchial damage pushed the decision to limit emissions. Formaldehyde also has non-cancer effects such as eye, nose and respiratory irritation and has been linked to the exacerbation of asthma and is connected to multiple chemical sensitivity.

Europe and Japan have established strong standards to reduce, or in Japan's case, virtually eliminate the use of formaldehyde and its emission into buildings from building materials used indoors.

The new California regulations set limits on emissions for products manufactured after January 1, 2009 that will be roughly equivalent to current European and Japanese standards and will exceed some with stricter limits in 2010 (and 2012 for some products). The California standards will not eliminate the use of formaldehyde for product manufacture, but will make formaldehyde-free alternatives much more competitive. The fallout of the California decision will be far wider than just in that state.

This decision also shows how green building programs can help accelerate the transformation of the building materials market toward healthier materials. Seven years ago, the US Green Building Council's LEED rating system began awarding a credit for use of composite wood products with no added urea formaldehyde, setting a high standard and sending a clear signal to the market. The credit helped catalyze market demand for a range of formaldehyde-free products, undermining standard industry arguments that healthier building materials cost too much and wouldn't be accepted by consumers.

Manufacturers still are allowed to use formaldehyde in composite wood products with the best technology to minimize the rate at which it is released. The regulation will, however, force drastic reductions in the emissions and make it much less economically attractive to use formaldehyde. This will create a strong incentive for the development and marketing of formaldehyde-free options.

Formaldehyde and Wood

All wood has some naturally occurring formaldehyde. But more formaldehyde is added to composite wood in the form of certain resins that are used to bind wood particles together. New methods are available and others are quickly being developed that reduce and even eliminate the need for formaldehyde.

Formaldehyde is a chemical used widely in building materials and many office and household products. It is also a naturally occurring compound that is a by-product of combustion and some decay and other natural processes.

The most widely used completely formaldehyde-free alternative resins are MDI (methylene diphenyl isocyanate) and PVA (polyvinyl acetate). A new soy-based adhesive developed recently may offer a safer green chemistry alternative.☼

Technical Reseach Committee News

Canadian Home Builders' Association

Advisory Documents on Steel Framing

The steel industry continues to develop support documents for use with their products and to encourage their use. The Fire and Acoustics Guide for Steel Framing (5th edition) is now available free from their website at *www.steelframing.org*. The Light Steel Framing Handbook & Illustrated Guide has been approved by CCMC and has been released although it will have to be updated to match the 2005 National Building Code. The Alliance is hiring a field representative to help builders go through the learning curve.

Plastic in Walls

The use of plastic in walls has evolved over the past generation. Promotion of the use of polyethylene started with the focus on improved energy performance of buildings in the mid 1970s. The poly was identified as a simple way to air seal the interior and also to provide a vapour barrier. However, over the years some have raised concerns that the extremely low permeability of polyethylene could be detrimental to the long-term durability of buildings. The concern may well be one that is dependent on the type of building as well as climatic conditions in which the building is located.

CMHC has sponsored a research project that is testing wall performance with and without poly in the walls at the University of Waterloo. Data is becoming available and modeling work will follow. A research highlight is expected later in the year outlining the project, issues and preliminary results, with another one after a full year of testing.

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.
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CSA Builder Advisory about Counterfeit and Non-Conforming Products

In recent years, there has been a growing concern about counterfeit and non-conforming building products. Sub-par or unsafe products can increase cost and liability for homebuilders and renovators and undermine the company's reputation and their relationship with customers. In the extreme, they can pose a serious safety risk, including the loss of life and property.

Although there is no evidence of a widespread problem, incidences of counterfeit faucets, locks, thermostats, electrical equipment, tools and safety gear have been reported, indicating the need for the industry to be on guard against products that are not what they appear.

Sub-par or unsafe products can show up:

- as counterfeit or "fake" brand name products;
- as products with fake certification symbols - i.e. fraudulent use of marks such as CSA, ULC and CGSB;
- as non-conforming products that do not meet accepted industry standards;
- as products evaluated for one function but used for other functions;
- or as no-name products without any indication of performance, durability or warranty.

As a new homebuilder or renovator, how can you safeguard yourself and your customers?

- Buy brands you know and trust by reputable manufacturers from suppliers you have an ongoing relationship with.
- Require your sub-trades to use products and brands that you approve.
- Understand manufacturers' warranties—what's covered and what's exempt? Warranties will often specify professional installation requirements, compatibility with other components and other issues that may affect coverage.
- As part of the sales process, explain your commitment to using quality products and why (e.g., performance, durability, warranty) to your customers.
- If allowances are part of the contract, recommend that your customers buy established brands from reputable sources only—discuss your concerns regarding online purchases, special sales, and so on.
- Include a disclaimer in the contract—i.e. you cannot be responsible for products provided by customers, for performance failures or collateral damages. Encourage customers to check with their home insurance provider on any possible concerns/guidance about product selection.

Anybody can unwittingly end up buying fake or sub-par products. To assist with purchasing decisions and reduce the risks:

- Be informed about the standards, mandatory or voluntary, that are applicable to all products you use in your projects; consult with manufacturers and suppliers. Also know the requirements of the applicable building code, which may specify particular levels of performance.
- Keep your purchasing staff up-to-date on issues related to "bad" products.
- Periodically check the websites of standards organizations for news releases and information on product recalls and alerts.
- Be skeptical. If a price is out of whack or too good to be true, it usually is.
- Be suspicious if the pick-up point is an unusual place.
- Be careful if you can't find any information about the manufacturer on the packaging or the product—most manufacturers want you to know who they are, including name and website address.
- If suspicious, check standards organizations online for legitimate approval (look for products directories or similar and follow the prompts).
- Report suspicions right away to the appropriate standards organization or to the retailer or supplier.

There is a lot to know about product standards, testing and certification. While most new home builders and renovators don't need to be experts in the topic, it is helpful to understand some of the details. This can also make it easier to explain the reasons for your selections to your customers. For instance:

- In addition to CSA, ULC and CGSB, there are a number of other organizations, some North American, who develop or manage standards, and whose marks appear on many of the products that go into new home construction or renovation projects. This includes ANSI/BHMA (American National Standards Institute/Building Hardware Manufacturers Association), ASME (American Society of Mechanical Engineers), IGMAC (the Insulating Glass Manufacturers Association of Canada) and GAMA (Gas Appliance Manufacturers' Association), to mention a few. All have websites, often including lists of certified products. Check for detailed information.
- At the National Research Council's Institute for Research in Construction (IRC), the Canadian Construction Materials Centre (CCMC) facilitates the entry into the marketplace of new and innovative construction materials and products for which there are no standards in place. Products are evaluated, and a CCMC Evaluation Number issued, along with an evaluation report that details the use(s) for which a product has been evaluated. CCMC also tests traditional products to existing standards.
- Standard compliance has different facets. Certification implies ongoing product testing—for instance, daily at the manufacturer's facility, or intermittently at test facilities. In some cases, approval may mean that a product sample has met the accepted standard and the manufacturer self-declares that the product continues to meet it. For some products, there may be a standard but no third-party testing procedures in place, and the manufacturer self-declares that the product complies with the standard.
- Non-conformance can have a geographical aspect. For instance, a window may meet wind load requirements for one area, but not in the neighbouring region. Not getting the appropriate products for a region can result in product performance failure, and hence warranty service callbacks, repairs and possible replacement with the new home builder or renovator likely being responsible for the cost.☼

Impact of Water Softeners on Septic Tanks

When a water softener is used to remove "hardness" (dissolved magnesium and calcium) from household water, it produces a salty "backwash" in the household's wastewater system.

Water softeners remove dissolved magnesium and calcium through ion exchange. Resin beads supersaturated with sodium "pick up" the calcium and magnesium and replace them with sodium. Then a sodium chloride brine is "backwashed" across the beads, picking up the calcium and magnesium and replacing them once again with sodium. Finally, this backwash solution, which now contains sodium chloride, calcium and magnesium, flows into the septic tank and eventually into the septic system's leaching bed.

Septic tanks rely on anaerobic and facultative bacteria to digest solids as they settle out of the wastewater. There is little conclusive information as to whether water softener backwash affects the settling of the waste or the action of the bacteria. While sodium inhibits anaerobic bacteria, it does so only at relatively high concentrations. Some studies suggest that magnesium and calcium, which are both present in the backwash, can counteract sodium's inhibitory effect on bacterial digestion.

A question that comes up is whether this backwash affects the performance of septic tanks. To determine the effect of water softener backwash on a septic tank's capability to process waste, a CMHC study looked at 75 home septic systems, some with water softener and some without. Sludge samples were tested in the laboratory for levels of sodium and chloride and for indicators of the extent of bacterial digestion. Results from the two groups were compared and analyzed to determine whether the differences found were significant.

The analysis showed that tanks receiving water softener backwash contained significantly higher levels of both sodium (Na) and chloride (Cl-) than those without water softener backwash. However, tanks receiving backwash did not differ significantly in terms of bacterial digestion, or in the composition of the effluent produced.

Another possible impact, which was not examined in this study, is the effect of water softener backwash on septic tanks' leaching bed permeability.

The composition of the effluent was analyzed to evaluate the effectiveness of the tank in removing contaminants from the wastewater. None of the indicators of tank performance differed significantly between tanks receiving water softener backwash and those that do not.

Performance of Leaching Beds

Although the performance of the leaching beds was not studied directly, sodium absorption ratios in the effluent of the two groups of tanks were compared. Sodium is known to cause clay to swell, reducing the permeability of the soil. However, this effect is counteracted by magnesium and calcium.

The amount of sodium relative to the amount of magnesium and calcium can be calculated. Previous studies have found that soils with a clay content of 15 per cent swell and become less permeable when the sodium absorption ratio exceeds 10.

In this study, effluent from tanks receiving water softener backwash showed significantly higher sodium absorption ratios than tanks that do not receive backwash. However, none of the tanks that produced effluent with a sodium absorption ratio of more than 10 showed any signs of inability of the leaching bed to drain properly. For leaching beds that had signs of failure, the clay content of the soil and the age of the system appeared to be the primary factors for the failure.

Based on this field study, it appears that water softener backwash discharged to a septic tank does not affect the tank's capability of effectively treating wastewater. Further research is needed to determine the effect of water softener backwash on the performance of septic tank leaching beds and on alternative treatment technologies. ☼

Impact of Water Softeners on Septic Tanks—Field Evaluation Study by Chris Kinsley, Ontario Rural Waste Water Centre, College d'Alfred, University of Guelph for Canada Mortgage and Housing Corporation

Melting Vinyl Siding

Numerous reports of melted and deformed vinyl siding are surfacing across North America as the popularity of the product has spread. The source of the problem reinforces the principle that a house is a system, greater than the sum of the parts, and that system could well be more than just the house itself, and with that surroundings need to be considered.

Energy Design Update, a US newsletter focused on energy efficient housing, recently highlighted the issue of window reflections on vinyl causing deformation and melting of the vinyl. Some Canadian builders have experienced similar situations here. The problem is greater than many would believe and that the vinyl manufacturers care to admit. In a report in 2002, the Vinyl Siding Institute issued a statement that it is "aware of rare incidents of thermal distortion of vinyl siding due to reflected light or radiated heat."

The American Architectural Manufacturers Association (AAMA – a window manufacturers association) was concerned enough about vinyl siding to create a task force to investigate the issue, however, neither they nor the vinyl manufacturers have shared any data.

Reflected light can concentrate the intensity of the sun's rays, creating hot spots where the reflection hits. It's not unlike the magnification of the sun's rays through a glass. Any surfaces in the vicinity could be a source of the reflection The most obvious are reflective surfaces such as glass, but it can also be roofing, pavement, water and probably in some circumstances, snow and ice.

A highly reflective surface, such as glass -- especially with a low-e coating--on a sheet that is curved, becomes a concentrating reflector. A surface in a location near the focal point of the concentrated beam thus becomes a target --a receptor of the concentrated energy in the light beam. That point thus sees the high temperatures. If that point is a piece of vinyl siding, it can deform. The typical heat distortion of vinyl siding is fairly low - between 160˚ and 165˚F (71 - 74˚C). Once these temperatures are reached, the siding may distort.

One condition that can deform the windows to create the surfaces that concentrate the sunbeam are changes in barometric pressures and temperature differences. High-pressure conditions, usually at the same time as good weather, can create a short-term deformation of the glass as air space is compressed.

There are many variables that can affect the reflections off windows. These include:

Angle of the sun in relation to the window

- ☞ Orientation of the window in relation to the vinyl siding
- ☞ Outdoor temperature and wind speed
- ☞ Distance of glass to vinyl
- ☞ Colour of the vinyl
- ☞ Deflection of the glass
- ☞ Solar reflectivity of the glass.

The problem is common enough that vinyl siding manufacturers have modified their warranties to exclude the effects of warping, melting or distortion due to external sources, including reflections.

Remedial actions that are suggested include:

- ☞ Installing a screen on the window that is the source of the problem
- ☞ Installing an awning over the window to break the line of light reflection
- ☞ Use of shrubs or other landscape elements to stop the line of reflected light or radiation.

The challenge, of course, is that the reflections may only be a problem for a short period of time during the year, when conditions are right. ☼

Rain Screen Products

Incidental moisture penetration of exterior cladding is best dealt with by incorporating a capillary break or ventilation space behind cladding systems to allow for the drying of the wall system.

The latest changes to the National Building Code which now require the use of rain screen assemblies in some parts of the country, and the increased attention to better construction practices in all parts of the country, has led to a number of manufacturers producing products that will help builders to achieve more robust construction without having to rely just on the quality of workmanship on site.

Rain screen detailing has a special interest in coastal BC because of the problems that have been experienced there. However, designers and builders should recognize that similar detailing is not just for the "wet" coast. Building envelope problems have been experienced in all regions, so rain screen detailing should be used in all parts of the country, especially on more exposed sites.

Rain Screen Materials and Building Code Requirements

The National Building Code requires that all exterior walls exposed to precipitation need to be protected against moisture ingress by a "first plane or protection and a second plane of protection incorporating a capillary break". (Sec 9.27.2.2)

In wet and high exposure areas, the capillary break must be a drained and vented space at least 10 mm deep behind the cladding, over the full height. The properties for the materials that provide a capillary break have not been defined by code. What needs to be considered is water absorption and susceptibility to moisture related deterioration of the materials. What is described by the code are the minimum dimensions: the ability to define a minimum 10 mm deep cavity, and that at least 80% of the area is open, so the capillary space defining material, such as strapping, mesh or whatever, can cover as much as 20% of the surface area. A variety of products can be used to create the capillary break.

We are concerned about reports from builders that some building officials are questioning the use of products such as Homeslicker because they don't have 'certification'. In some cases they are refusing to allow the use of such products. Such an interpretation is wrong and beyond the requirements of the building code. We don't understand what product standards the officials will be satisfied with since there are no product standards for rain screen materials.

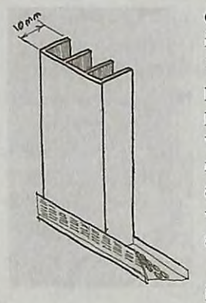
What has to be considered is that the installation be done carefully, to minimize moisture penetration past the cladding, and allow any moisture that does penetrate, to drain. An appendix note in the building code points out that a variety of products can be used to provide the capillary break "including a variety of non-moisture susceptible, open mesh materials."

Imasco Minerals Inc.
Surrey, BC
Tel. 604-888-3848
www.imascominerals.com

Rain Screen Strapping: Vyna Strap

The most important component of a rain screen is the element that defines the rain screen cavity. The most commonly used material on the west coast is pressure-treated plywood, cut into 1-½" straps.

Imasco Minerals has introduced its Vyna Strap vinyl strapping. It is a rigid PVC product that functions as a spacer between the outside wall of the building and the exterior cladding. It helps maximize airflow through the envelope. The Vina strapping contains a number of channels, reducing the contact area with the wall. It is 10 mm deep, thus meeting the Building Code's 10 minimum cavity requirement. As it is not a solid panel, it is 37% lighter weight than an equivalent piece of plywood. Since it is made of window grade vinyl (with 80% recycled content), it does not retain moisture nor will it rot, and stainless steel fasteners are not required. However, unlike wood strapping which can carry some weight, the vinyl simply acts as a spacer.



The system includes a perforated base channel that provides an insect screen.

Mortairvent®

Cladding systems such as stucco, stone and brick are durable, but still develop hairline cracks that can allow moisture to penetrate and collect in the wall. Conventional construction practices have placed manufactured stone and stucco directly on the house wrap and plywood sheathing, allowing moisture that enters the wall system to become trapped, which in time will cause rotting and general wall deterioration.

Mortairvent® is a blue polymer mesh that creates an airspace/capillary break that is a self-draining rain screen for use behind manufactured stone, stucco, EIFS and brick wall systems. It has vertical channels creating an air and drainage space while a gray filter fabric on the face provides backing for stucco. This product looks very similar to Benjamin Obdyke's Homeslicker (Solplan Review No. 130, September 2006), and can be considered as a variation, as it was developed in conjunction with Benjamin Obdyke.

Mortairvent is manufactured by Advanced Building Products of Horsham, PA. It is distributed across Canada.

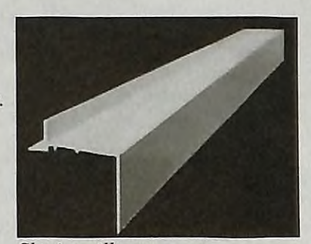
Advanced Building Products, Inc.
Phone: 800-252-2306
www.advancedflashing.com

Sillsaver: Window Sill Flashing Alternative

Sillsaver Industries Ltd. of Chilliwack, BC has developed a patented sloping pan that can be used in window openings to provide sill protection to the wall assembly.

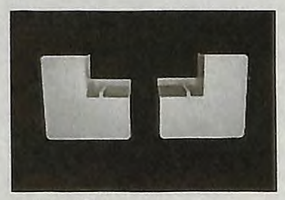
The pan is a made from an extruded high impact PVC with a sloping base. It comes in 12' 0" lengths and can be cut on site to specific sizes. Since it replaces the "peel & stick" and metal pan currently being used in coastal BC, it can be installed in any weather condition, and is compatible with a variety of materials. The slope ensures that water will be drained away.

For the corners, there is a one-piece moulded corner that is sealed to the sill piece. A spacer support holds the window away from the base. For rain-screen applications, the spacers can be glued onto the base protruding out by the thickness of the rain-screen and touching the back side of the window flange.



Sloping sill pan

support spacer



corner pieces

Information:
Sillsaver Industries Ltd.
Tel: 604-999-1576
www.sillsaver.com

Letter to the Editor

I would like to thank you for the articles in Solplan Review. I was a builder and am now in product development, and still am an active member of CHBA. It is great to get your reviews of products and techniques.

I am writing to pass on a way to ventilate an attic space on gable end roofs. I came across this while building a warehouse.

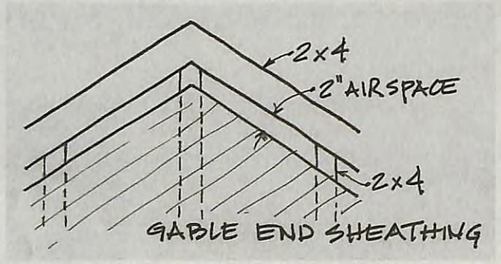
I used steel roofing and did not want to use a ridge vent as I have had fine wind-driven snow blow right through them. I also do not like the look of gable vents or roof vents and I don't think they give the best results. As I thought about it, and realized that I typically use 2x6 for my rough fascia, it occurred to me to leave my sheathing down 5½" on my gable truss, leaving a 2" air space between the bottom of the top cord of the truss and the sheathing. Except for the 2x4 gable studs, this leaves both ends of the roof vented and when I installed perforated soffit up the gable and put in an F channel, you could not tell that anything was done differently.

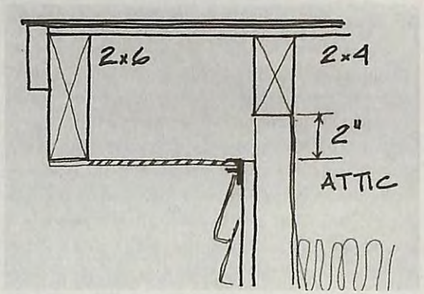
This past winter the wind was very strong and with the bitter cold temperatures, the snow was very fine. I checked the attic often to ensure there was good air movement. There was no sign of snow blowing in.

I wanted to share this detail with you so you may be able to inform other builders of this simple technique that works well, does not cost any more (other than a little planning) and helps get rid of some of those pesky vents.

I should also mention that at the bottom where the attic insulation is, I closed off these areas to about 6" higher than by blown-in fiberglass insulation and had no movement in the insulation.

Brent Cliff
Fredericton, NB





You Asked Us: About Insulating Concrete Forms

Do insulated concrete forms off-gas? Would a heat recovery ventilator need to be running on low to remove this gas?

Insulated concrete forms do not off-gas. Most are made with expanded polystyrene ("beadboard") insulation which is blown with steam and is quite inert. This insulation product is used in many applications around a home, and there should be no concerns about emissions.

You need to have a heat recovery ventilation system running continuously to provide the required fresh air exchange for occupancy, but that is a separate issue unrelated to the construction materials.

You Asked Us About: Radiant Heating System Costs

I keep hearing that radiant heating is more energy efficient than other heating systems. Suppliers say I can save at least 10% on heating compared to a forced warm-air heating system. Others say it's not so. Is there any truth to the supplier claims?

There is little credible research showing that radiant floor heating will cost less to use than forced air heating. One study comparing two similar houses in the US showed that radiant heating systems in fact used more energy.

Radiant heating offers a warmer floor which is welcome especially when the weather is cold outside, people want to walk around in bare feet, or if they wish to avoid the air movement that is a part of a forced air heating system, but that is a qualitative feature of the radiant system.

The rationale behind the claim that radiant systems are more energy efficient is that with the "more comfortable" radiant heat, which heats the surfaces of the room (i.e. increases the mean radiant temperature in the environment), thermostats can be kept at a lower temperature setting, keeping the air temperature slightly lower than in a forced air heating system. With a lower setting, it will lead to energy savings.

CMHC did a research study to see what settings occupants were actually keeping in houses with in-floor heating, and compared them to the settings in comparable houses with other heating systems.

Fifty houses with radiant in-floor heating and 25 houses with other heating systems (forced air, hot water baseboard, etc.) in Nova Scotia were compared. The main floor thermostat settings for the 50 houses with radiant in-floor heating systems averaged 20.4°C, while the main floor thermostat settings for the 25 control houses with other heating systems averaged 19.8°C.

A previous study measured an average temperature of 20.2°C in Nova Scotia houses with forced air systems. A national energy use survey of Canadian houses found the average daytime setting in all Atlantic houses was 19.9°C, with an evening setting of 20.6°C.

The CMHC study showed that homeowners with radiant in-floor heating systems do not, in fact, set their thermostats at lower settings than homeowners with other types of heating systems. Consequently, there will not be the energy savings due to lower thermostat settings with in-floor heating systems. Some energy savings are still possible by the use of zoning of the in-floor systems, but that would also be true of other systems that permit zoning (e.g. baseboards, radiators, etc.). ☼

CSA B214 - Hydronic Heating Systems

The latest edition of *CSA B214 Installation Code For Hydronic Heating Systems* has been published. This version supersedes a previous edition that was published in 2001.

This Code sets out the minimum provisions for the installation, extension, alteration and renewal of hydronic heating systems. It applies to open and closed hydronic heating systems including:

* hydronic space heating
* radiant heating (wall, floor, ceiling)
* convectors
* fan coils
* combo systems
* indirect-fired domestic water heating
* pool and spa heating
* snow melt systems
* other auxiliary systems

The previous edition was written more as a "best-practice guide" and was therefore not suitable for reference in the National Building Code. Numerous comments from industry and from a Joint Task Group established by the Canadian Codes Centre resulted in a series of changes in this edition that focus on minimum safety requirements. CSA expects that this version will be referenced in the next edition of the building code. In the interim it can be used by installers, designers and local jurisdictions.

CSA standards are available for purchase from CSA regional offices, by phone at 1-800-463-6727 or at *www.csa.ca*

Energy Answers

Rob Dumont

What's all the buzz about the Factor 9 Home? Haven't most of its features already been showcased in other demonstration homes?

For those of you who haven't heard about it, the Factor 9 Home (*www.factor9.ca*) is a new demonstration home in Regina that is targeted to use nine times less energy per square meter of floor area than conventional 1970s homes, and two times less purchased water per square meter of floor area. Its annual purchased energy target is 30 kilowatt-hours/square metre (108 megajoules/m^2 or 9520 BTU/square foot).

The Factor 9 Home is not Net Zero in energy performance, but it is targeted to do substantially better than past demonstration houses built in Canada's prairie region.

How will the house differ from past demonstration houses?

1. The house is deliberately designed to look like a conventional house. There is no "in-your-face" technology on the outside of the house that would intimidate the average buyer. See Figures 1 and 2 for views of the front and back of the house. For most families, their house is their single largest asset, and most people do not want to stray too far from conventional design. The Factor 9 Home addresses this concern.

2. A deliberate attempt was made to use technologies with relatively low incremental costs. Good solar orientation, better insulation, better windows, good air sealing, a good air-to-air heat exchanger, a wastewater heat exchanger, low cost tanks for water storage—all of these technologies have modest incremental costs. The one higher cost item isthe active solar heating system, which has 20.4 square metres (220 square feet) of vertical south facing panels, and a 2,350 litre (520 imperial gallon) water storage tank.

Figure 1. View of the south side of the Factor 9 Home. 220 square feet of active solar heating panels are mounted at approximately mid-height on the south wall of the house.

3. The south roof of the house is photovoltaic-ready. As the price of photovoltaic panels drops, the panels can be added to the roof.

4. The house, although not powered by photovoltaics, does use energy efficient lights, appliances, and heating and ventilating equipment. Many past demonstration houses have focused mostly on reducing the space heating and water heating loads. As space and water heating loads are reduced, the electricity loads become proportionally greater. Unlike BC, Manitoba, and Quebec, Saskatchewan generates most of its electricity from fossil fuels (primarily lignite coal) with the accompanying major carbon dioxide emissions. Each kilowatt hour of electricity produced in the province releases about 0.84 kilograms of carbon dioxide. By contrast, in Quebec, where virtually all electricity is generated by water power, the figure is 0.01 kilograms per kilowatt hour (84 times less!). Mostly compact fluorescent lamps and Energy Star Appliances areused in the Factor 9 Home. In addition, a low electricity use heat recovery ventilator (air-to-air heat exchanger) (about 50 watts to deliver 30 L/s [63 cfm]) courtesy of Venmar, and a low electricity use fan coil (Enerzone) were installed.

5. An innovative portable device will be used in the home to give the occupants an instantaneous readout of the electricity consumption in the house in both kilowatts and dollars/hour. Studies in the United States have found that this device allows home owners to reduce their electricity consumption by about 10% to 15% through more careful usage of appliances and lights. "What gets measured, gets managed." [The November 2006 issue of Solplan Review has an article about the Powercost Monitor and The Energy Detective.]

6. Space cooling is being provided without the use of a refrigeration compressor. The outdoor design temperature in July [2.5%] is 31 °C in Regina. A network of plastic pipes is positioned in the 22 concrete pilings supporting the house. The approximate annual temperature at the base

Figure 2. View of the north side of the Factor 9 Home

of the pilings is about 5 °C. Heat will be rejected from the fan coil into the network of cooling pipes. No freons, no refrigerants other than water, and no compressors are used.

7. Water efficiency measures are used in the house, along with roof water capture to reduce the water consumption for the house. Low flush toilets, a low water-use dishwasher, a low water-use clothes washer, low flow shower heads and aerating faucets, and low water-use landscaping are all featured. Two large flexible plastic tanks with a total volume of 19,000 litres are located beneath the basement floor. The water supply for these tanks is roof water, and this water will be used for flushing toilets and for watering the outdoor landscaping.

It is true that a lot of the technology in the house is not "brand-new". For instance, the Greeks about 2,500 years ago figured out that for both space heating and space cooling reasons it was desirable to orient houses towards the south. The message of the Greeks, however, has yet to reach the planners who lay out the subdivisions in almost all new neighbourhoods in Canada. Progress with city planning has been on the slow side.

In our society, we have a fascination with the new and unusual. It is true that most of the ideas used for the Factor 9 Home are not revolutionary. However, the greatest problem with housing innovation is not a lack of brand new ideas but rather the lack of adoption of known technologies.

A demonstration house can help to raise awareness of good practises for home construction, whether or not the ideas are "new". That is my hope for the Factor 9 Home.☼

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NRC·CNRC

*hyg*IRC software for designing better envelopes

By John Burrows and Jim Gallagher

Controlling the deposition of water in wall cavities is an important consideration that has taken on even more importance with the advent of tighter construction. For this reason, the NRC Institute for Research in Construction (NRC-IRC) has developed information and design software, *hyg*IRC, to help practitioners design and construct optimal building envelope assemblies.

Designed for engineers, architects, building scientists, contractors and other professionals, the program simulates the hygrothermal responses of each envelope element to changing conditions on either side of the building envelope. While allowing the user to vary interior conditions and select outdoor climate conditions, *hyg*IRC is able to:

- Predict temperature and moisture response within the various layers of a given wall assembly over time;
- Compare the hygrothermal response of different wall assemblies for different scenarios of climate loading (indoor and outdoor).

The software is founded on two comprehensive databases. The climate database contains 30 to 40 years of hourly weather data for 19 Canadian and 6 US cities. The materials database contains the hygrothermal properties of more than 80 common construction materials. The user can view all the relevant hygrothermal properties of any material including water vapour permeance, liquid diffusivity, air permeability, heat capacity, and thermal conductivity, all of which have been verified at NRC-IRC's thermal and moisture performance laboratory.

An upgraded version of the software, *hyg*IRC 1-D v.1.1, has recently been released, reflecting its continual development and improvement. In addition to including climate data for six additional North American locations, the update has several new features that improve the program's function and versatility such as the ability to:

- Alternate between SI and I-P units at any time while running the program;
- Use same-year multiple times from the weather database;
- Provide more flexibility in setting the exterior boundary conditions.

*hyg*IRC 1-D makes it possible to conduct case studies in which several parameters such as climate, material, and configuration are changed one at a time to gauge the sensitivity of wall hygrothermal performance to these changes. This allows designers to explore various "what-if" scenarios – for example, what if the stucco cladding were replaced with acrylic stucco. (Situations involving air leakage, water leakage or gravity, or any others that need to be examined in two dimensions are still best handled using *hyg*IRC 2-D.)

*hyg*IRC 1-D can simulate the response of each building envelope element to changing environmental conditions on either side of the envelope on an hourly basis, producing information on the temperature and relative humidity distributions within the wall assembly and the changes in both over time.

In addition to the extensive weather and material properties databases available with *hyg*IRC 1-D, the model allows users to input their own data on weather, interior conditions and material properties and also provides them with easy-to-use tools for output analysis.

In March 2007 NRC-IRC researchers in charge of the development of the software conducted a one-day training clinic on the applications of the software for the design of exterior walls. The participants – a mix of building scientists, building envelope consultants, architects, engineers and public building owners and managers – appreciated the hands-on approach of the clinic along with the coaching from NRC-IRC software developers. It provided ample opportunity to explore the capabilities of the software and relate these to their needs. The team is planning to offer a similar clinic in French in the fall.

For more information about *hyg*IRC, contact Khaled Abdulghani at (613) 998-6807, or e-mail at *Khaled.Abdulghani@nrc-cnrc.gc.ca*. To learn more about *hyg*IRC, view a demo version or order, visit:

http://irc.nrc-cnrc.gc.ca/bes/software/hygIRC/index_e.html

John Burrows is an Ottawa-based consultant and technical writer. Jim Gallagher is Manager of Publication Services at NRC-IRC.

Understanding R-2000, Energy Efficiency and Green Building

Most builders love to hate Mike Holmes. He is an effective communicator who often points out construction shortcomings. We may not like his stressing construction problems, but that is the nature of entertainment programs. Whether we like it or not, he does provide a public service, exposing questionable practices and showing the viewer that construction is a complex process.

With a building background he seems to have credibility with the public.

Thus it was disappointing to see his column in the Globe and Mail newspaper recently where he badmouthed the R-2000 Standard. He fell into the same trap so many others have – picking on a small portion of the standard – the higher levels of insulation and more airtight construction – while ignoring that *the house-is-a-system*. He mistook the R-2000 standard as just an insulation standard.

The R-2000 Standard was developed in the late 1970s as a reaction to the energy situation at the time. Its focus was primarily on energy performance. However, from the outset, the standard recognized the house is a whole system. It was recognized that energy efficient construction practices require attention not only to insulation and air sealing but also to the provision of adequate air change. The R-2000 home always includes a mechanical ventilation system to provide continuous air change for good indoor air quality. That is why mechanical ventilation has always been an integral part of building R-2000 homes.

Ongoing scientific monitoring has shown that homes built to the R-2000 standard have superior indoor air quality.

Holmes also suggested that R-2000 did not allow the use of alternative building materials and insulation products. He evidently does not understand that the R-2000 standard is a performance standard – there are no materials or systems that would be unacceptable for use, as long as the energy performance target for the house is met and the home is properly ventilated.

There is nothing in the standard precluding the use of straw bales, insulated concrete forming systems, or any number of other innovative construction materials and systems being developed, as long as they make good building science sense. Many new R-2000 homes are built using such techniques (with the possible exception of straw bale, which has limitations as to where it may be appropriate to use).

Holmes implied the LEED program is a better, more up to date standard. LEED does address more environmental concerns, but what many do not appreciate is that LEED also has a significant energy efficiency component. Green building is not just "green" construction practices. The embodied energy content of materials (their environmental impact), while significant, are a smaller impact over the life of the building than the energy consumption of the building to keep it operating. When the Canadian version of LEED is developed (it is still in the development stage), it will in part rely on the R-2000 protocols and energy performance criteria. ☼

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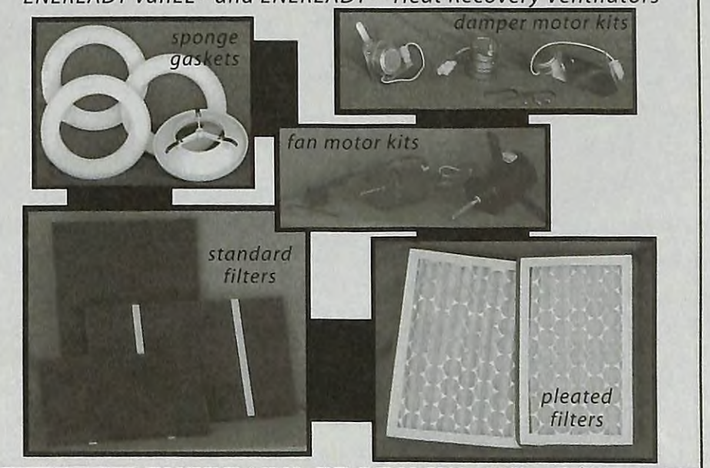

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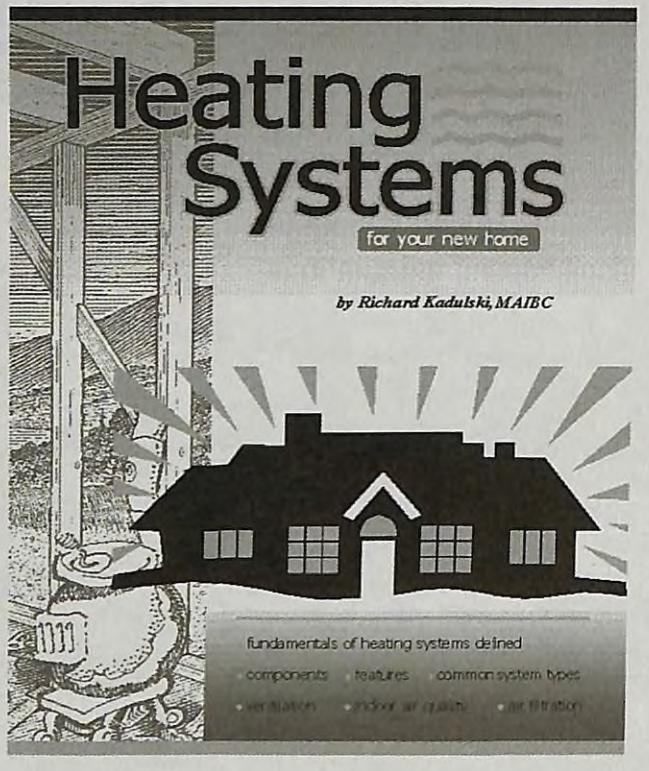

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